NOTES ON THE HOST PLANTS OF THE LORANTHACEAE IN THE NILGIRIS

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Fischer in 1926 contributed extensively to our knowledge of the host affinities of the loranthacean plant parasites or the mistletoe of south India. However, little work has been done since then on the host ranges and affinities of these species, but for the host range of a few species recorded by Narasimha and Rabindranath (1964). I made some observations and notes on the host range of the loranthacean species in the Nilgiris during the course of a two-year study on ornithophily.

In this paper the name loranthus is used as a common name to indicate the semi plant parasites that fall under the family Loranthaceae. A recent development in the classification of the mistletoe has been the formal separation of the Loranthaceae into two separate families Loranthaceae and Viscaceae (Kuijt 1969).

The host plants of the Loranthaceae listed in this paper is neither complete nor exhaustive. However, some interesting host-parasite combinations are dealt with, and an effort made to identify the causes that may underlie them, as this could lead to a greater understanding of their phylogeny and evolution.

The study area, the Nilgiri Hills, lies between latitude 11° 8′ and 11° 37′ N., and longitude 76° 27′ and 77° 4′ E. The area receives rainfall from both the NE and the SW monsoons. The differences in rainfall, temperature and altitude in different parts of the district contribute to make the flora of this district varied and rich. Heavy rainfall on the western slopes supports a moist evergreen forest at elevations between 900 m and 1200 m. Slopes with less rain have a moist mixed deciduous type of forest, and in dry areas the dry deciduous forest. At about 1500 m the southern subtropical hill forest, the transitional belt of the shola forest intergrades with the shola forest. The southern montane wet temperate forest or the shola forest occurs above 1700 m, and is confined to the hollows and ravines on the hillsides. The southern montane wet grasslands cover large areas on the hillsides.

Several reasons have been put forward to explain the inability of a loranthus to establish itself on certain plants. The mechanical properties of the host species bark that prevent penetration by the haustoria of the parasite, the biochemical incompatibility of the parasite and host systems, and the light or shade requirements of the loranthus are some of them. The habits and movements of the birds that disperse the seeds of this parasite could also play a large role in determining the host species (Kuijt 1969).

One of the obvious reasons for the restriction of the host range of a certain species of loranthus is its limitation to a certain biotope or vegetational type, by environmental factors. This limits the number of host species the loranthus can parasitise. In the Nilgiris, loranthi such as *Dendrophthoe neelgherrensis* and *D. memecylifolia* are limited geographically to the montane evergreen forests as they occur only above a certain elevation on the southern hills. Other species such as *Scurrula*

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cordifolia and *Helixanthera intermedia* have a wider altitudinal tolerance and occupy two or three vegetational zones on the slopes. *Helixanthera intermedia* occurs between the altitudes of 1000 m-2000 m and straddles two to three vegetational zones. In the lower elevations it is found in the moist deciduous type of vegetation, where the tree predominantly attacked is *Toona ciliata*. Its range extends through the subtropical hill forest to the shola forest proper where its commonest host plant is *Symplocos laurina*. *Dendrophthoe falcata* possesses a high degree of adaptability to different environmental conditions. It has a very wide host range with 343 recorded host plants (Narasimha and Rabindranath). It is an extremely polymorphic species and two different forms may not seem to have much resemblance to each other, and intermediate forms also occur. Wiens (1971) maintains that due to the extreme variation of forms and their lack of geographical consistency the variety subgrouping serves no useful purpose. However, I feel that the varieties should be delimited as it would make the different forms easier to describe. Besides there is strong evidence to suggest that the habit of this parasite varies with the habitat in which it is found. The form with long leathery leaves and yellow flowers is found in the dry deciduous biotope. This habit is possibly an adaptation to xerophytic conditions. The plants it commonly parasitises are *Zizyphus mauritiana*, *Z. xylopyra*, *Acacia* spp., and *Albizzia* spp., the dominant trees in dry deciduous forest. The form with white flowers and falcate leaves occurs most commonly in the moist mixed deciduous forests, and it may occur to a less extent in wetter and in drier areas. The form with amplexicaule leaves is found in much wetter conditions on the slopes from 625 m to the shola forests. There is a significant amount of geographic consistency between the different forms and isolating mechanisms possibly operate to make them more distinct from each other.

In *D. falcata* with amplexicaule leaves, colour of the flower varies from deep red to pink. In the sholas the trees most commonly attacked by this loranthus are *Syzygium cuminii*, *S. arnottianum*, and less often the shrub *Rhodomyrtus tomentosa*. There is a possibility that it extended its range up the hillside by parasitising a tree species also common in lower elevations. Another common host is the woody climber *Dalbergia gardneriana*. This climber grows over several trees in the shola forming a tangle of vegetation. In one instance the climber was heavily infested with *Dendrophthoe falcata*, while not a single clump was found on any of the trees supporting the climber.

In a mixed forest certain species are found to be highly host selective. It would be interesting to know why a loranthus confines itself to a few host species when there is an ample choice of hosts. In the temperate regions with stands of a single or a few species of trees it may be advantageous for the mistletoes to be host selective (Kuijt 1969). Though in a heterogenous tropical forest a high degree of host selectivity seems disadvantageous unless the parasite has also evolved a successful dispersal system to propagate the parasite onto the required host. More study is required before it is established whether loranthus with a wide host range is more or less successful or advanced than loranthus with a limited host range (though success in parasitism cannot necessarily be equated with an advanced nature).

Helixanthera hookeriana is a loranthus confined to the altitudinal zone of 1200-1700 m on the slopes of the western ghats complex. In the Nilgiris it is found in the moist mixed deciduous tract on the slopes. I have recorded this loranthus on only one species of host *Mallotus philippinensis*. Fischer in

1926 recorded this loranthus on the above host species only. The reasons for such a narrow host range in a forest supporting numerous species of trees and shrubs is not, as yet, known. The limited geographical distribution and narrow host range of this loranthus could indicate an advanced nature though it also makes it vulnerable to extermination. This is an entomophilous species unlike the rest of the species in this district that are ornithophilous. The few species in this genus whose pollination has been studied are known to be ornithophilous though also visited by insects. *Helixanthera hookeriana* has bisexual flowers, and its structure suggests an ornithophilous ancestry. With exceptions typical insect pollinated loranthus are unisexual (Kuijt 1969). Entomophily in this case suggests an advanced nature. The fruits are dispersed by the flowerpecker.

All the species of loranthus in the Nilgiris are propagated by birds. The most common agent for dispersal is the flowerpecker, *Dicaeum concolor*. At lower elevations both *Dicaeum agile* and *D. erythrorhynchos* are present. Nearly all the species of loranthus in the Niligiris are dispersed by *Dicaeum*, the common method is by discarding the epicarp, swallowing the viscid seed and excreting it on to a branch (Sálim Ali 1931). However, *Macrosolen parasiticus* is also dispersed by frugivorous birds such as bulbuls and the barbets.

Dendrophthoe memecylifolia, an endemic Nilgiri mistletoe found above 1700 m has a very limited host range, most often, if not always, the tree parasitised being *Vaccinium leschenaultii*. Fischer's paper in 1926 lists five host plants for this parasite. I have recorded it on four host plants, three of which are common with Fischer's list. I have found this parasite only once each on the host species other than *Vaccinium leschenaultii*. To give an example : in a hectare of shola forest comprising of numerous shola trees, 10 out of the 17 *Vaccinium leschenaultii* were parasitised by *Dendrophthoe memecylifolia*. This loranthus was not found on any other shola tree. *D. memecylifolia* produces a very limited number of fruits by comparison with the other loranthi. The fruiting period is very short, and the fruits are dispersed by *Dicaeum concolor*. The fruits of *D. memecylifolia* start to ripen when *Vaccinium leschenaultii* is in fruit though past its peak. The fruits of *V. leschenaultii* are a great favourite with *Dicaeum concolor* and the birds move from one tree to another feeding on them. I have observed the bird consume a few fruits of the loranthus along with those of the host, and possibly the seeds are excreted on the next tree the bird visits. Apparently, birds could be one of the important factors that determine the host plant of *D. memecylifolia*.

In *Macrosolen capitellatus* which occurs upto an elevation of 1500 m, flowerpeckers (observed species *Dicaeum concolor*) use a different technique to disperse the seed. The flesh alone is eaten, the epicarp is dropped and the seed is rubbed off from its bill onto a branch. The bird plucks a fruit, flies a short distance away to a bare branch and proceeds to eat the flesh. Usually the bird stays close to the source of berries repeatedly visiting the clump for more fruit. As the seed is not taken to a distance it is common to see a tree fully infested with this loranthus.

Many cases of hyper-parasitism have been recorded, and usually *Viscum* parasitising a loranthus is common. In these cases too the bird plays the major role.

In Coonoor the fruiting of the loranthus is spread over the year. Thus the bird does not have more than one to three species of loranthus in fruit to contend with at any given time of the year. The activity of the *Dicaeum* may differ at different times of the year, and this could also be a reason why a host species sometimes supports only a certain

species of loranthus and not others. Though ringed birds have not been followed, the *Dicaeum* is apparently territorial around a few clumps of loranthus in fruit, and apparently restricts its feeding to that area. The perch preference of the *Dicaeum* could also determine the subsequent dispersal of the seed. A small bird like the *Dicaeum* would normally prefer thinner branches to perch on.

Light is an important controlling factor in the distribution of loranthus in a forest, light tolerant or the light intolerant species selecting habitats as per their requirements. *Helixanthera intermedia* above 1500 m predominantly parasitises *Symplocos laurina*, and one of the factors could be that *Helixanthera intermedia* is a light tolerant branch inhabiting loranthus, and this particular host plant could offer possibilities for exposure to light. *Helixanthera intermedia* growing in shady conditions show listless growth and poor flowering, the flowers being pale. *Taxillus cuneatus, T. recurvus* and *Helixanthera wallichiana* appear to be light tolerant. *Dendrophthoe memecylifolia, D. neelgherrensis* appear to be light intolerant. Though some species of loranthus including *D. neelgherrensis* grow both in light and shaded conditions.

Certain species have a wide host range. *Dendrophthoe neelgherrensis* which occurs above 1500 m and is a highly successful parasite of many of the indigenous as well as the introduced vegetation. It is the only loranthus that has parasitised *Eucalyptus globulus*. It had been suggested that the eucalyptus due to rapid exfoliation of its bark does not encourage attack by the loranthus (Bidie 1874). Since then it has been noted that the loranthus does attack *Eucalyptus globulus* (Fischer 1926). *Eucalyptus ficifolia* is parasitised by *Macrosolen parasiticus*. I have seen *D. neelgherrensis* not only on the extremities of the branches of *E. globulus* but also on the main trunk where the bark is shed rapidly. *Dendrophthoe neelgherrensis* 'travels' along the branches of the host by means of epicortical roots, producing haustoria at intervals. Epicortical roots are not true roots as they arise from the base of the plant and not from the radicle. Loranthus such as *Dendrophthoe memecylifolia, Taxillus cuneatus, T. recurvus*, and *Macrosolen parasiticus* produce epicortical roots, and *Dendrophthoe falcata* with amplexicaul leaves, *Helixanthera intermedia*, and *Helixanthera hookeriana* do not have epicortical roots. Trunk inhabiting loranthus seem prone to developing epicortical roots, even within a species the clump on the trunk produces more epicortical roots than that on a thin branch.

The introduced *Acacias* from Australia are attacked by most of the loranthus. Fruit trees like the plum, peach and pear are most suspectible to attack by *Taxillus recurvus* and *Taxillus cuneatus*. Many other introduced species of trees and shrubs are attacked by many species predominant among them being *Dendrophthoe neelgherrensis*, whereas some species of loranthus are not found on any exotic vegetation at all. Fischer notes that Monocotyledons are not attacked bythe mistletoe. However in Ooty Botanical Gardens I have seen *Taxillus recurvus* parasitising *Cordyline australis* of Agavaceae, a monocot introduced from New Zealand.

Resemblance between the foliage of the loranthus and that of its host is rare. The resemblance, if present may be accidental. However, the foliage of *Dendrophthoe memecylifolia* resembles that of its main host plant *Vaccinium leschenaultii* to such an extent that it is difficult to make out the parasite in vegetative condition. The host plants of a species of loranthus generally do not have any similarity or relationship to each other, though *Dendrophthoe trigona* is found very often on species of *Ficus*. The loranthus and its host plant do not have a common pollinating agent, nor does it appear that

flowering in the host influences flowering in the parasite.

The little that is known about the host preferences of the parasite, could be augmented by detailed study on loranthus seed germination, penetration and successful parasitism of various host plants. The influence of factors like rainfall, humidity, temperature, and passage of the seed through the alimentary canal of the bird on germination needs to be known. The habits and movements of the birds involved in loranthus propagation merit study to determine the role they play in host selection. The life span of a clump of loranthus needs to be determined. I have noticed clumps of loranthus dying for apparently no reason on a perfectly healthy host plant. Detailed study would possibly clarify the main factor or factors involved in host selection. The damage done by the loranthacean species on natural vegetation and cultivated plants needs to be assessed.

LIST OF HOST PLANTS OF THE LORANTHACEAE

SPECIES OF LORANTHUS	SPECIES OF HOST
Helixanthera hookeriana (W. & A) Danser M. Arg. (1200 m-1700 m)	*Mallotus philippinensis* M. Arg.
Helixanthera intermedia Wt. (Danser) (900 m-2200 m)	*Gordonia obtusa* Wall. *Toona ciliata* Roem. *Ilex wightiana* Wall. *Meliosma pinnata* (Roxb.) Walp. * *Acacia melanoxylon* R. Br. *Photonia notoniana* W. & A. *Symplocos laurina* (Retz.) Wall., Rehd. & Wills. *Dendrophthoe falcata* (Linn.f.) Etting.
Scurrula parasitica Linn. (300 m-2500 m)	*Toona ciliata* Roem. *Dalbergia lanceolaria* L.f. *Dalbergia latifolia* Roxb. *Acacia caesia* Willd. *Acacia* sp. *Albizzia* sp. *Anogeissus latifolia* Wall. *Premna cordifolia* W. *Emblica officinalis* Gaertn.
Taxillus recurvus (DC.) van Tieghem (1500 m +)	*Meliosma simplicifolia* (Roxb.) Walp. * *Acacia dealbata* Link. * *Acacia melanoxylon* R. Br. * *Prunus domestica* Linn. * *Prunus persica* (Linn.) Batsch. * *Pyrus communis* Linn. * *Nerium odorum* Soland. * *Cinnamomum camphora* Nees *Elaeagnus kologa* Schlecht *Glochidion neilgherrense* W. *Celtis wightii* Pl. *Salix tetrasperma* Roxb. * *Cordyline australis* (Forst.) Hook. f.

SPECIES OF LORANTHUS	SPECIES OF HOST
Taxillus cuneatus (Roth)	
	* *Cryptomeria japonica* (Linn. f.). D. Don
	* *Citrus aurantium* Linn.
	* *Citrus medica* Linn.
	* *Hibiscus rosa-sinensis* Linn.
	Meliosma simplicifolia (Roxb.) Walp.
	* *Acacia dealbata* Link.
	Photonia lindleyana W. & A.
	* *Prunus domestica* Linn.
	* *Prunus persica* (Linn.) Batsch.
	* *Prunus cerassoides* D. Don
	* *Pyrus communis* Linn.
	Syzygium cuminii (Linn.) Skeels.
	Wendlandia thyrsoidea (Roem. & Schult.) Steud.
	Maesa perrottetiana A.DC.
	Ligustrum perrottetii A.DC.
	Lasiosiphon eriocephalus DC.
	Celtis wightii Pl.
	Salix tetrasperma Roxb.
Dendrophthoe falcata (Linn. f.) Etting widespread	*Bombax ceiba* Linn.
	Toona ciliata Roem.
	Zizyphus mauritiana Lamk.
	Zizyphus xylopyra (Retz.) Willd.
	Mangifera indica Linn.
	Dalbergia gardneriana Benth.
	Dalbergia latifolia Roxb.
	Acrocarpus fraxinifolius Wt.
	Tamarindus indica Linn.
	Acacia ferruginea DC.
	* *Acacia dealbata* Link.
	* *Acacia melanoxylon* R. Br.
	Acacia leucophloea Willd.
	Albizzia sp.
	Terminalia chebula Retz.
	Anogeissus latifolia Wall.
	Rhodomyrtus tomentosa Wt.
	Psidium guajava Linn.
	Syzygium arnottianum Walp.
	Syzygium cuminii (Linn.) Skeels.
	Tristania conferta R. Br.
	Maesa perrottetiana DC.
	Tectona grandis L.f.
	* *Grevillea robusta* A. Cunn.
	Mallotus philippinensis M.—Arg.
	* *Celtis serotina* Pl.
	Celtis wightii Pl.
	Morus alba Linn.
Dendrophthoe trigona (W. & A.) Dans. (900 m)	*Dalbergia latifolia* Roxb.
	Ficus bengalensis Linn.
	Ficus mysorensis Linn.
	Ficus glomerata Roxb.
	* *Nerium odorum* Soland.

Species of loranthus	Species of host
Helicanthes elastica (Desr.) Dans.	*Grewia tiliaefolia* Vahl
	Zizyphus sp.
	Pithecolobium dulce Benth.
	Mallotus philippinensis M. Arg.
	Euphorbia antiquorum Linn.
Dendrophthoe neelgherrensis (S. & A.) Dans. (1300 m +)	* *Cryptomeria japonica* (Linn. f) D. Don
	* *Magnolia grandiflora* Linn.
	Mahonia leschenaultii Tak.
	* *Camellia japonica* Linn.
	Gordonia obtusa Wall.
	Eurya japonica Thunb.
	Nothapodytes foetida (Wy.) Sleumer.
	Ilex wightiana Wall.
	Ilex denticulata Wall.
	Microtropis ramiflora Wt.
	Turpinia cochinchinensis (Lour.) Mers.
	Meliosma simplicifolia (Roxb.) Walp.
	* *Acacia dealbata* Link.
	* *Acacia decurrens* Willd.
	* *Acacia melanoxylon* R. Br.
	Pygeum wightianum Bl.
	Photonia lindleyana W. & A.
	* *Prunus cerassoides* D. Don
	* *Syncarpia glomulifera* (Sm.) Nied.
	* *Eucalyptus globulus* Labill.
	* *Lagerstroemia indica* Linn.
	Schefflera racemosa Harms.
	Sehefflera capitata Harms.
	* *Luculia gratissima* SW.
	Viburnum punctatum Buch.-Ham. ex D. Don
	Xantolis tomentosa (Roxb.)
	Vaccinium leschenaultii Wt.
	Rhododendron nilagiricum Zenk
	Ligustrum lucidum Ait.
	Phoebe paniculata Nees
	Litseae ligustrina Hk. f.
	* *Hakea acicularis* Kn.
	Dendrophthoe falcata (Linn. f.) Etting.
	Celtis wightii Pl.
	Salix tetrasperma Roxb.
	* *Platanus orientalis* Linn.
	* *Quercus cerris* Linn.
Dendrophthoe memecylifolia (W. & A.) Danser (1500 m +)	*Pittosporum nilghirense* W. & A.
	Vaccinium leschenaultii Wt.
	Rhododendron nilagiricum Zenk
	Rapanea wightiana Mez.
Macrosolen parasiticus (Linn.) Danser (900 m, 1500 m-2400 m)	* *Cryptomeria japonica* (Linn. f.) D. Don
	Microtropis ramiflora Wt.
	* *Acacia melanoxylon* R. Br.
	Anogeissus latifolia Wall.
	Syzygium arnottianum Walp.

Species of loranthus	Species of host
	* *Eucalyptus ficifolia* F.v. Muell.
	Maesa perrottetiana A.DC.
	Phoebe paniculata Nees.
	Cinnamomum wightii Meissn.
	* *Celtis serotina* Pl.
	Celtis wightii Pl.
	Salix tetrasperma Roxb.
	* *Ficus elastica* Roxb.
Macrosolen capitellatus (W. & A.) (1000 m-1500 m)	*Maesa perrottetiana* A. DC.
	Ficus tjakela Burm.
	Ficus spp.
	Artocarpus integrifolia Linn.

* introduced species

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* Not referred to in the original.